

# (12) UK Patent Application (19) GB (11) 2 359 492 (13) A

(43) Date of A Publication 29.08.2001

(21) Application No 0029722.6

(22) Date of Filing 06.12.2000

(30) Priority Data

(31) 10009020

(32) 25.02.2000

(33) DE

(71) Applicant(s)

**Richard Wolf GmbH**  
(Incorporated in the Federal Republic of Germany)  
Pforzheimer Strasse 32, D-75438 Knittlingen,  
Federal Republic of Germany

(72) Inventor(s)

**Manfred Boebel**  
**Dieter Metsch**  
**Sybill Brüstle**  
**Adolf Gallinat**

(74) Agent and/or Address for Service

**Baron & Warren**  
18 South End, Kensington, LONDON, W8 5BU,  
United Kingdom

(51) INT CL<sup>7</sup>

**A61B 1/012**

(52) UK CL (Edition S )

**A5R REW**

(56) Documents Cited

**US 5343853 A**

**US 5320091 A**

**US 4841949 A**

**US 4178920 A**

(58) Field of Search

UK CL (Edition S ) **A5R REN REP REW REYX**

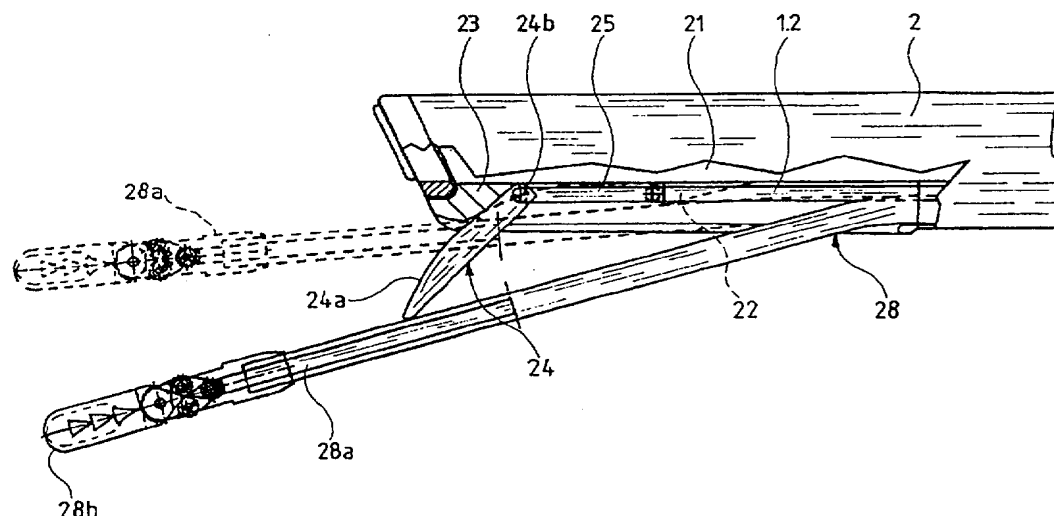
INT CL<sup>7</sup> **A61B 1/00 1/005 1/01 1/012 1/015 1/018 1/12**  
**1/303 1/307**

(54) Abstract Title

**Hysteroscope**

(57) A hysteroscope comprising an inner shank 21 and an outer shank 2 surrounding the inner shank forming a longitudinal channel 1.2, a first fitting 32 for supplying rinsing fluid through the inner shank 21, a second fitting 13 for removing rinsing fluid via the longitudinal channel 1.2 and a third fitting 39 through which an auxiliary instrument 28 is introducable into the hysteroscope and is distally movable through a working channel 38, 1.2. A deflection means is provided comprising a first ramp 22 on which, sliding up, the distal end 28a of the auxiliary instrument 28 is deflectable into a first position and, a pivotable deflection element 24 which deflects the distal end of the auxiliary instrument into a second position beyond the first position.

Fig.2



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print incorporates corrections made under Section 117(1) of the Patents Act 1977.

GB 2 359 492 A

Fig.1

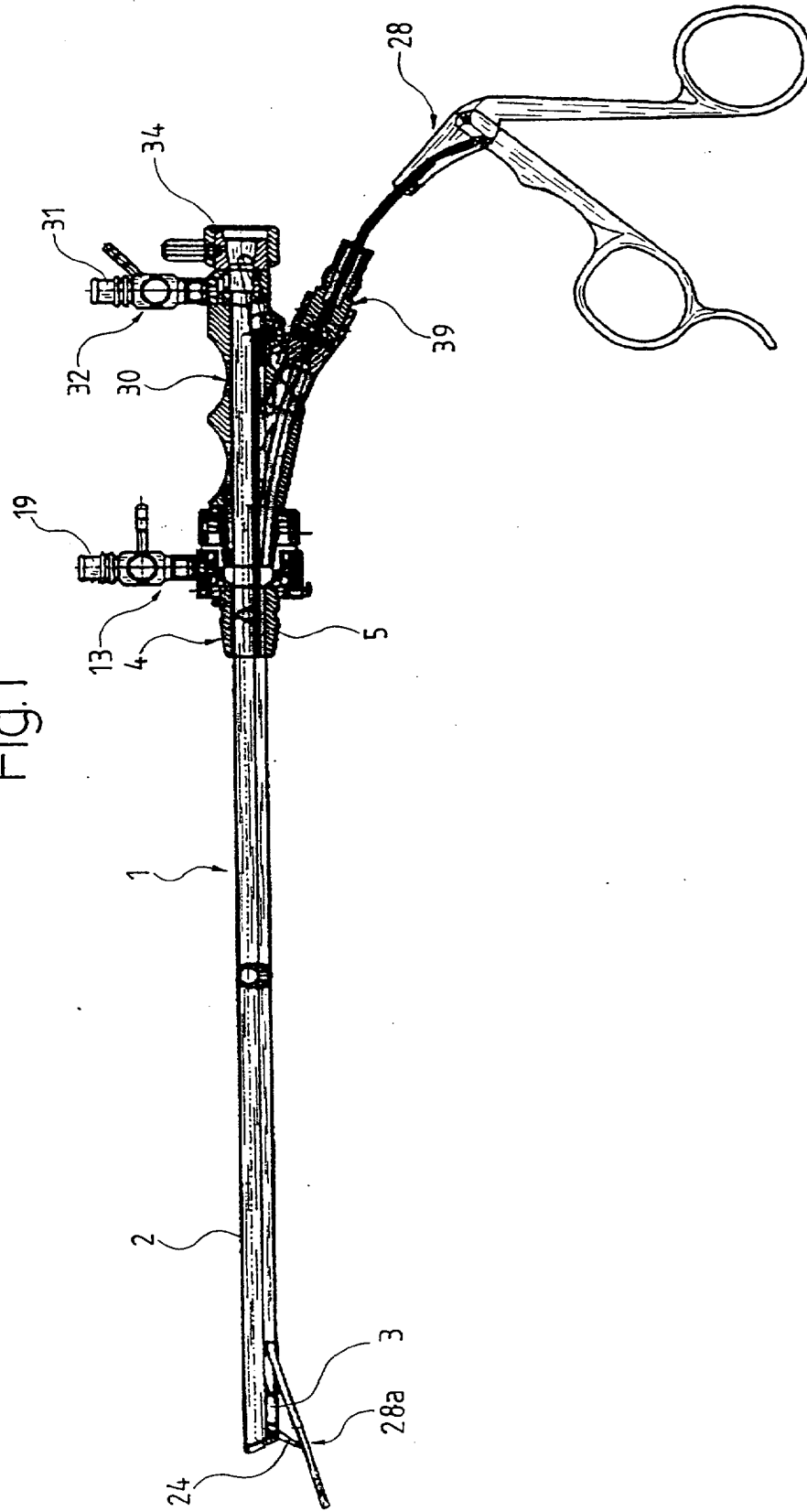


Fig. 2

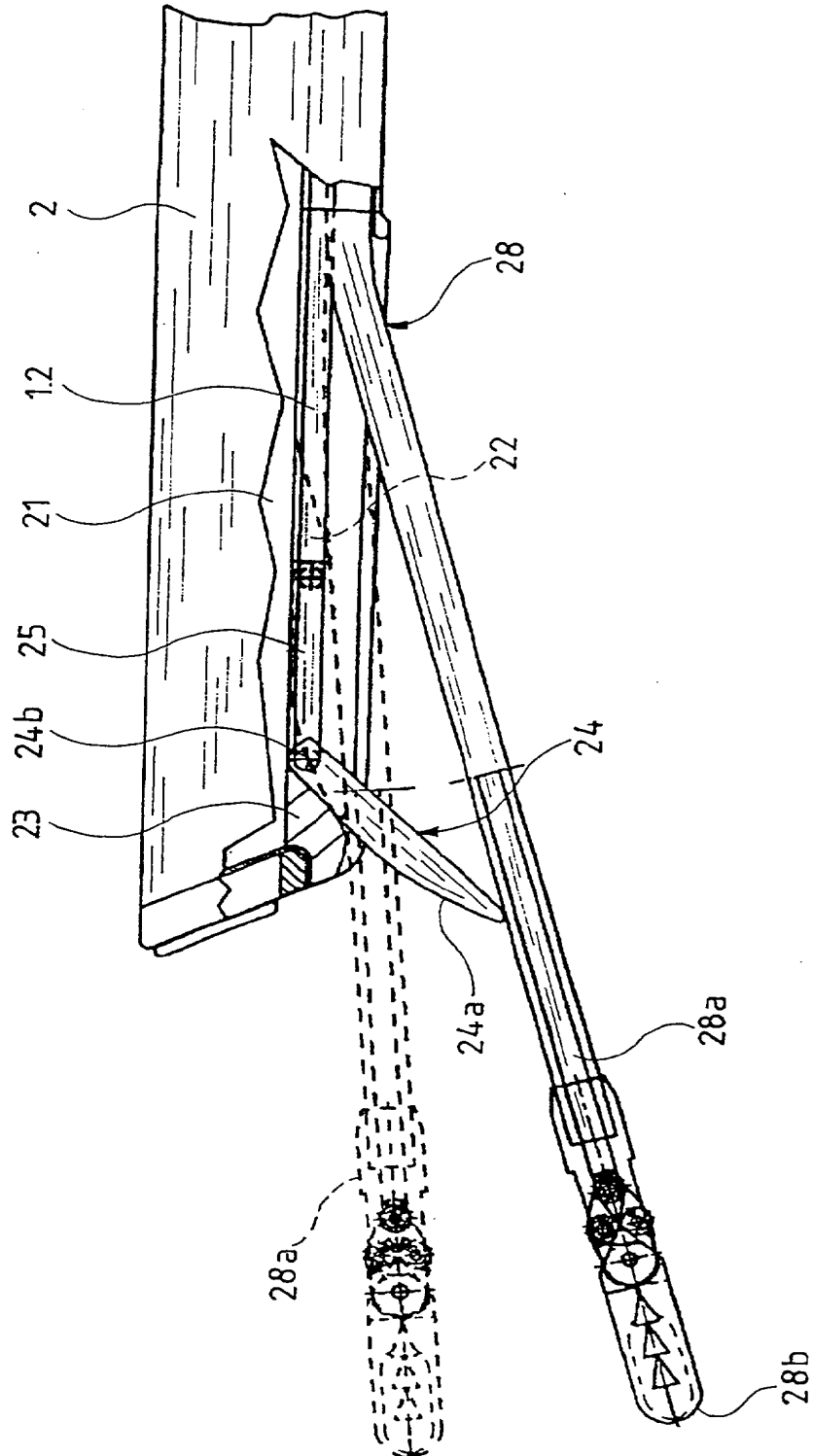


Fig. 3

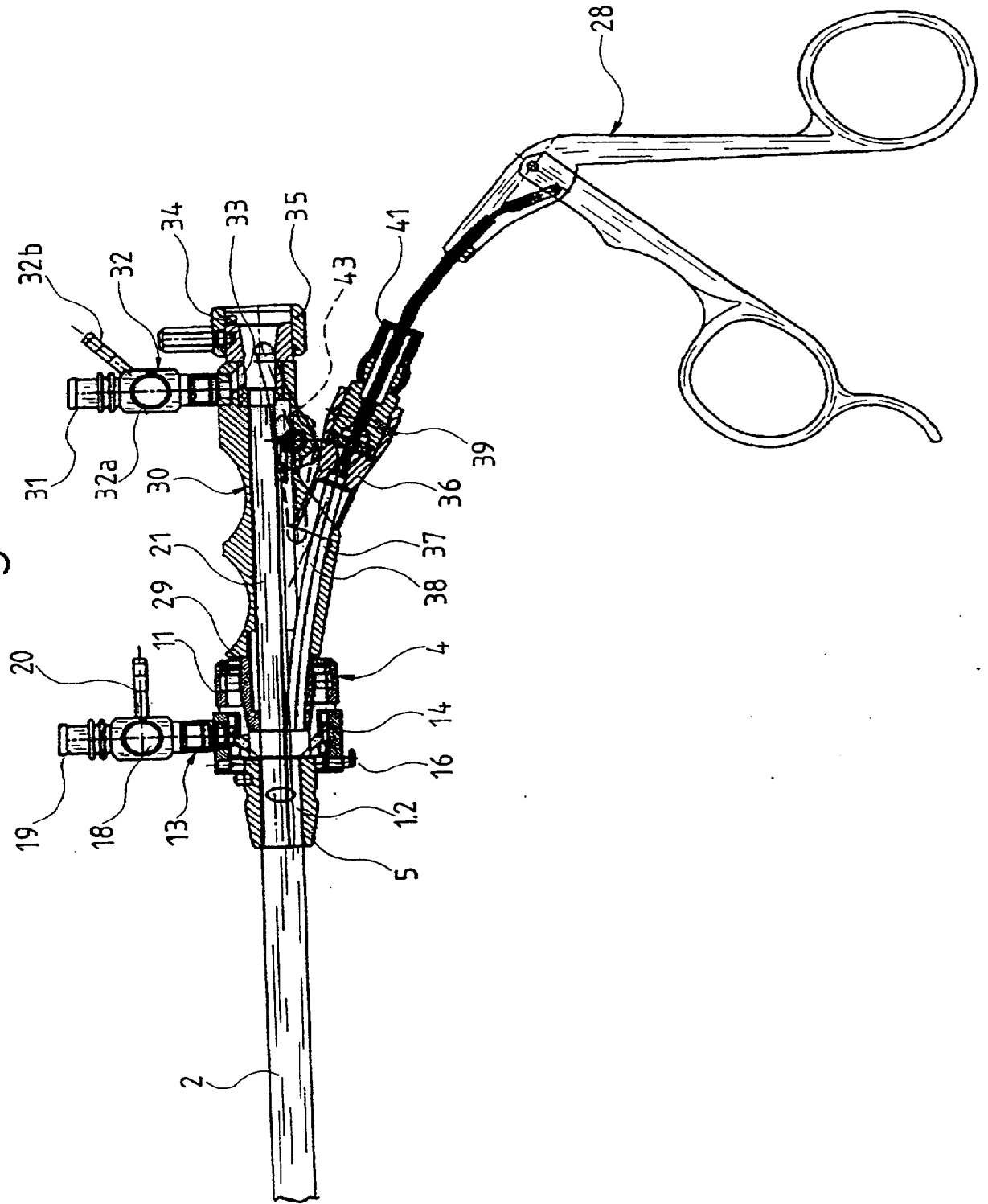
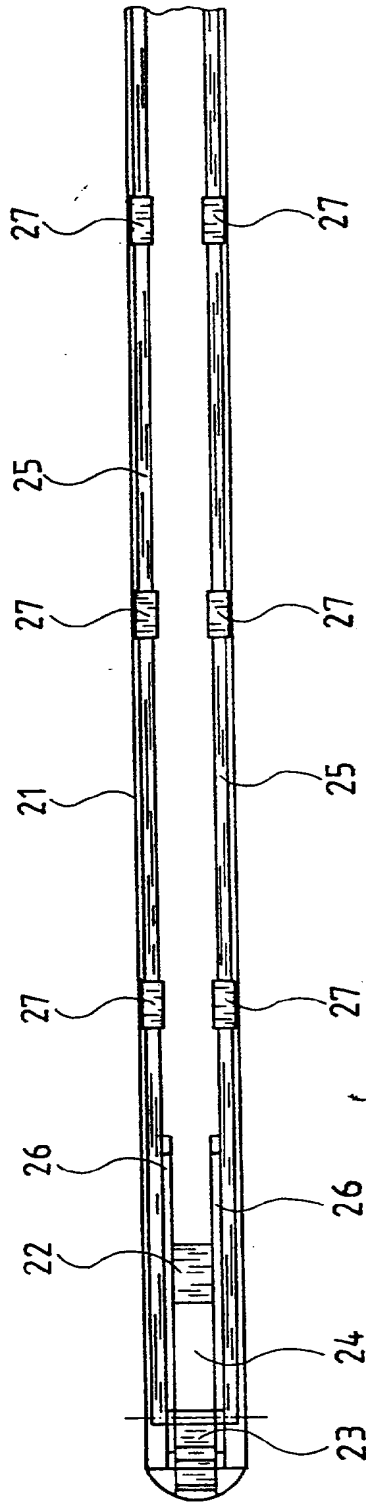


Fig.4



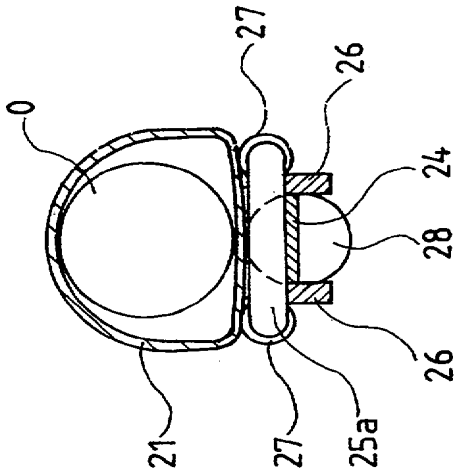


Fig. 4a

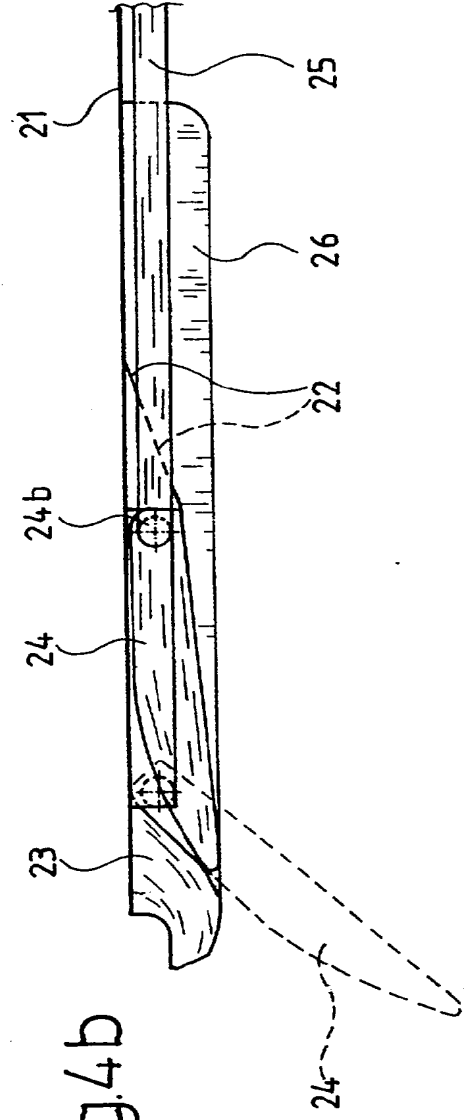


Fig. 4b

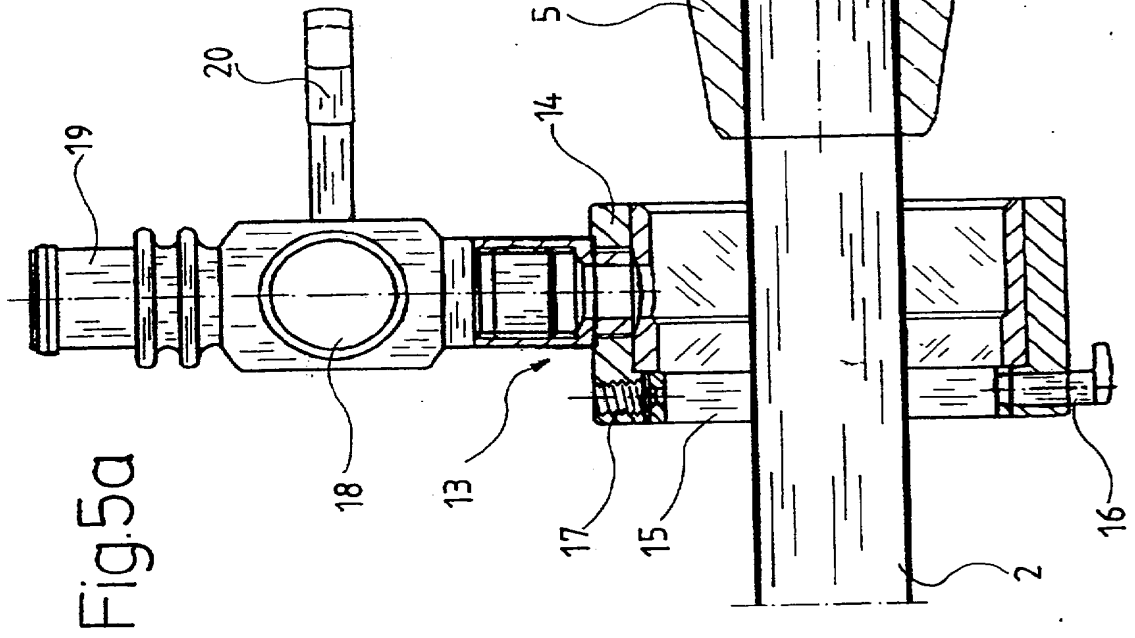


Fig. 5b

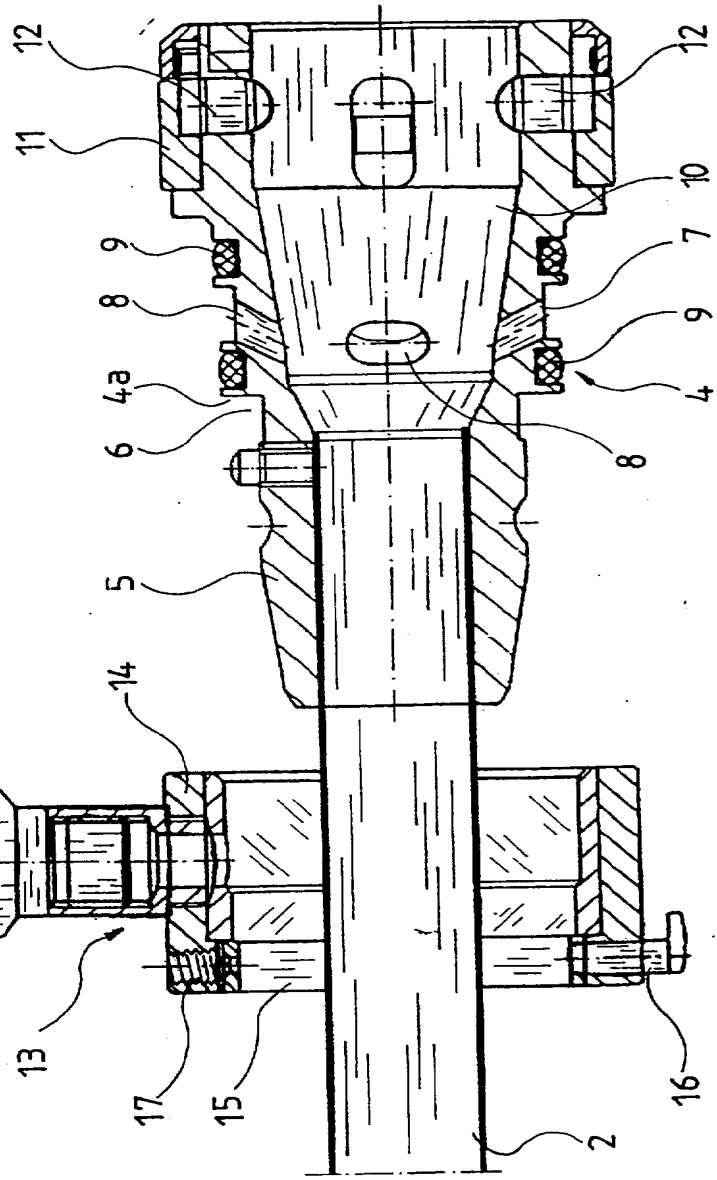


Fig. 5c

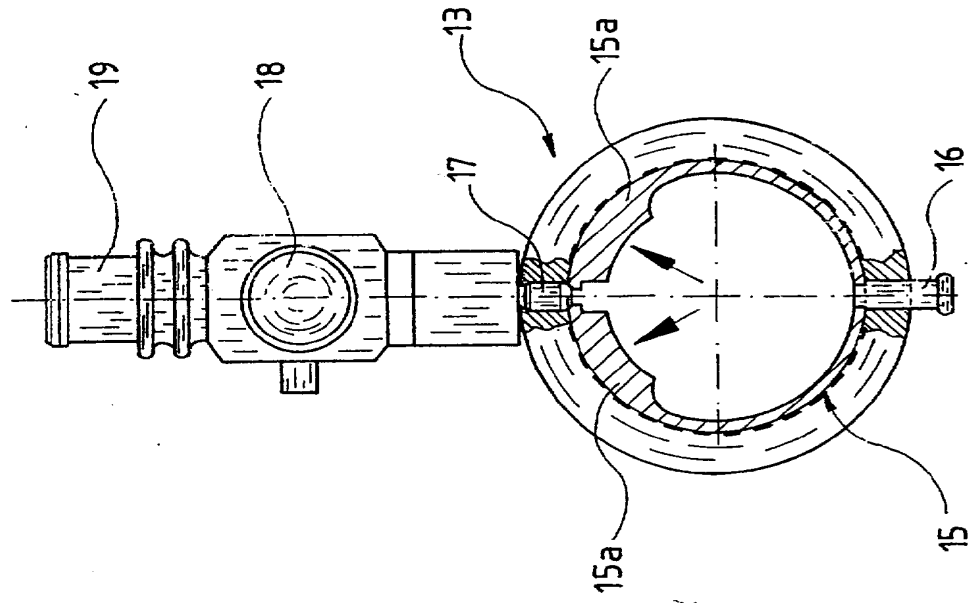




Fig. 6

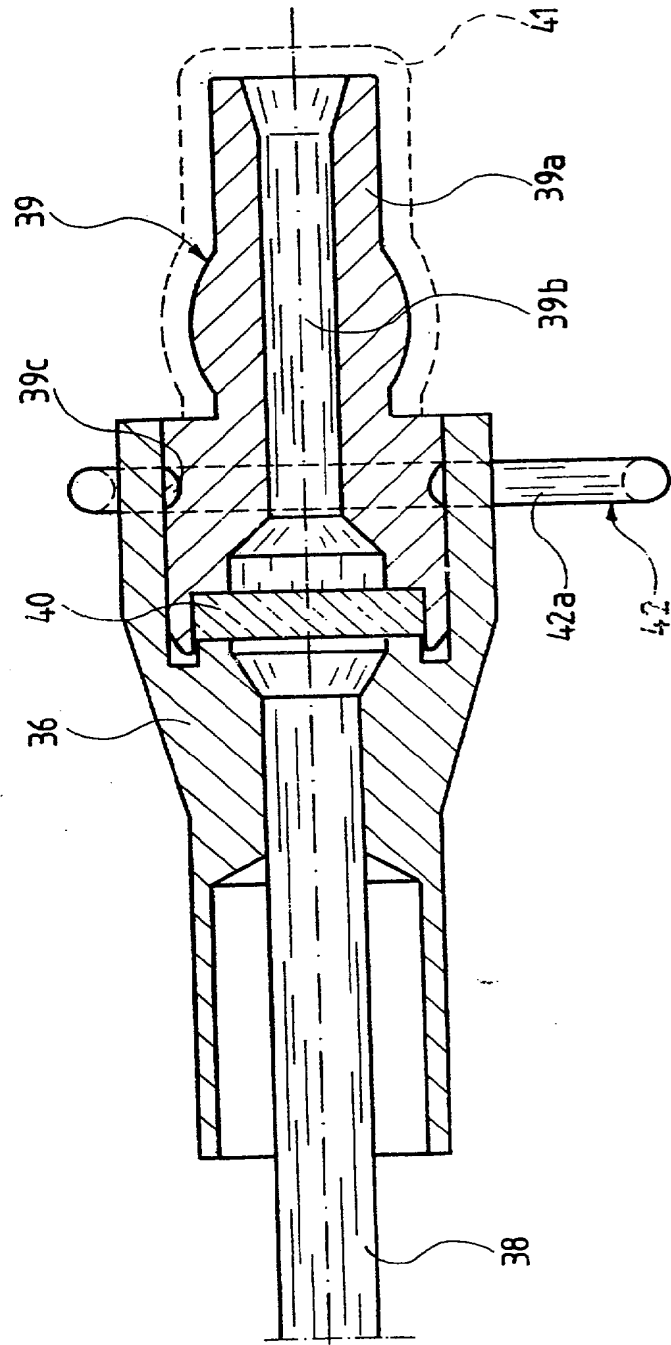
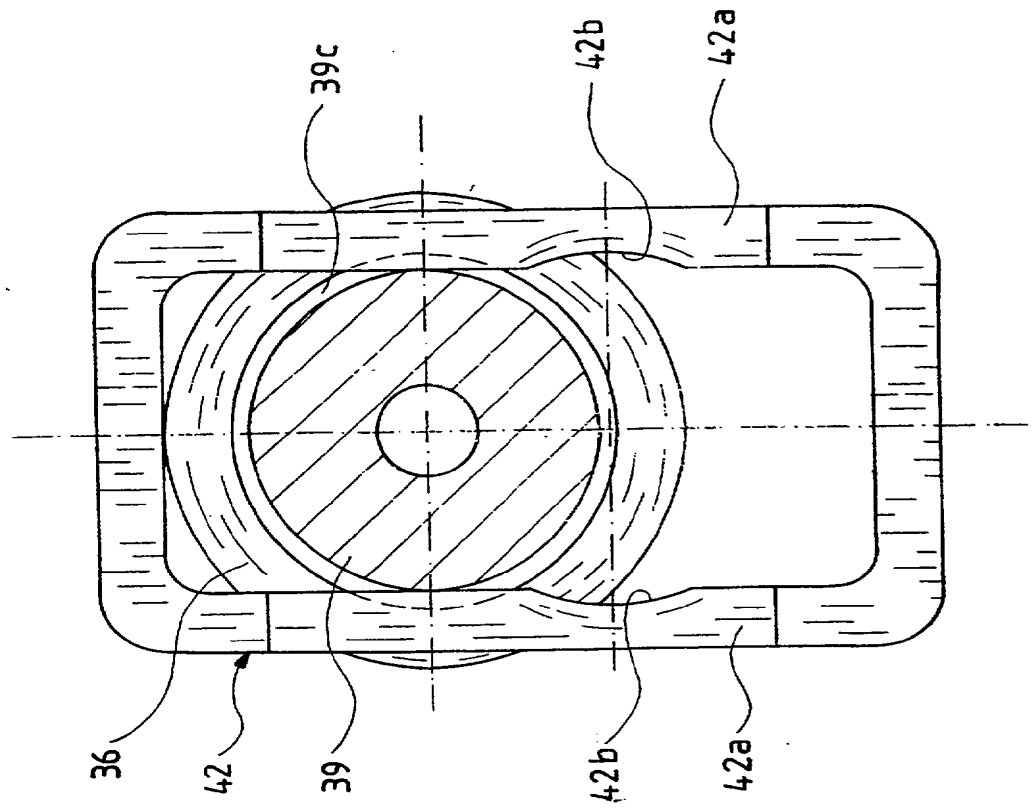


Fig.6a



5

### A hysteroscope

The invention relates to a hysteroscope for carrying out endoscopic operations in the uterus by way of an auxiliary instrument, consisting of an inner shank and an  
10 outer shank surrounding the inner shank whilst forming a longitudinal channel, of a first fitting for supplying rinsing fluid to be led through the inner shank into the uterus and of a second fitting for removing rinsing fluid from the uterus via the longitudinal channel, of a third fitting at which the auxiliary instrument is  
15 introducable into the hysteroscope and is further distally movable through a working channel, and of deflection means with which the distal end region of the auxiliary instrument is elastically laterally deflectable.

With such operation hysteroscopes e.g. with the help of forceps and laser probes as auxiliary instruments, myomas on or in the uterus wall are removed, and spe-  
20 cifically with the simultaneous rinsing of the body cavity in order to ensure a good viewing of the operational region by way of optics running through the endoscope. There is also required a lateral deflection of the distal end of the end section of the auxiliary instrument, which projects out of the endoscope, in order to be able lead the end of the auxiliary instrument freely and unhindered to the  
25 operation location.

The deflection with the use of flexible auxiliary instruments is not problematic and may be carried out with a pivotable lever located distally on the endoscope, also called an Albarran lever. Possible is also a lateral deflection of the distal  
30 auxiliary instrument by way of a ramp (US 2,129,391 and US 5,947,994).

This however does not function with semi-rigid or relatively rigid auxiliary instruments since for their deflection relatively large bending forces are required which may not be mustered by a pivotable lever or deflection element without supporting measures. Although an elastic deflection of relatively rigid end sections of auxiliary instruments via the oblique surface of a ramp is possible, the ramp however may not be too steep since otherwise the auxiliary instrument may not be slid over the ramp or only with a destructive force. Furthermore a ramp with a relatively low inclination may lead to the disadvantage that the auxiliary instrument end may not be deflected laterally enough.

The object of the invention lies in the solution of these problems. Furthermore there is to be put forward a hysteroscope which to a great extent may be disassembled for cleaning purposes and which has a favourable design of the respective fittings for the supply and removal of the rinsing fluid as well as for introducing the auxiliary instrument.

For achieving this object the hysteroscope of the above mentioned type is further designed according to the invention such that there is provided a first ramp on which, sliding up, the distal end of the auxiliary instrument moved distally through the hysteroscope is deflectable in order with a further distal movement of the auxiliary instrument to bring its distal end region into a first position, and that there is provided a deflection element with which the distal end region of the auxiliary instrument is deflectable into a second position beyond the first position, and specifically to a greater or lesser degree according to requirement.

The first ramp may in principle be designed relatively flat with a low gradient so that the distal auxiliary instrument end may be pushed easily over the ramp and deflected into its first position by bending, which quasi may be considered as a supporting and preparatory measure for the when required subsequent further deflection into a second position by pivoting out the deflection element, since then this procedure too is possible without an excess force effort, after the distal

end region of the auxiliary instrument in advance has just already been brought into an intermediate position by the ramp.

5 The deflection element designed as a pivotably mounted lever by way of a distal displacement out of a rest position, with a second ramp is pivoted against the distal end region of the auxiliary instrument in order to deflect this end region into the second position. With this the pivot bearing of the deflection element is usefully axially displaced with two parallel actuation rods which run through stationary guides attached at the outside on the inner shank and whose distal  
10 ends blend into a transverse web which runs through parallel slots into guides parallel to one another and likewise attached on the outside and on the inner shank, and which forms the pivot pin of the deflection element.

15 The ability of a hysteroscope of this or another type to be disassembled more easily amongst other things is achieved in that the second fitting is designed as a rinsing attachment, at the proximal end of the outer shank there is provided a coupling part with a cone, and the rinsing attachment may be placed from the proximal onto the cone, is displaceable proximally further onto the coupling part and is rotationally connectable to the coupling part in a manner lying against an  
20 abutment.

The rinsing attachment is equipped with a slotted clamping ring whose limbs on pushing onto the cone are elastically spread open and after the complete pushing of the rinsing attachment onto the coupling part under return deformation engage  
25 into an annular groove on the coupling part in order thus to fix the rinsing attachment by way of a positive fit connection. Furthermore on the coupling part there is provided a further annular groove which in cooperation with an annular housing part of the mounted rinsing attachment forms an annular channel which on the one hand is in connection with the channels of the rinsing attachment  
30 which lead the rinsing fluid and on the other hand via bores in the coupling part is in connection with a channel between the inner shank and the outer shank.

A useful connection of the two shanks results when in the coupling part there is provided a cone receiver into which from the proximal there may be pushed a coupling cone which is seated on the inner shank and which by way of latching elements is releasably connected to the coupling part.

5

Furthermore proximally to the coupling cone there may connect a handle on whose proximal end there is provided a first fitting whose parts leading the rinsing fluid via an obliquely proximally running channel are in connection with the channel forming the inner shank. Furthermore on the proximal end of the handle there may be provided a coupling with which optics insertable into and through the inner shank may be fastened on the inner shank.

10

The ability of a hysteroscope to be disassembled for cleaning purposes may furthermore be achieved in that the fitting, on which the auxiliary instrument is introduced into and through the working channel of the hysteroscope, is equipped with a quick change valve which has a longitudinal channel for leading through the auxiliary instrument, is partly inserted into a connection piece and by way of a bar may be fastened in the connection piece.

15

The quick change valve is on the distal side equipped with an elastic, centrally slotted sealing disk and proximally on its introduction connection piece projecting out of the connection piece is provided with a sealing cap which is placed on this and is provided centrally at the proximal end with a slotting through which the auxiliary instrument via the valve longitudinal channel and further through the slotted sealing disk may be distally pushed into a working channel.

20

25

The fixing of the quick change valve in the connection piece may be effected such that the bar displaceable transversely to the longitudinal channel of the valve, in a blocking position with two oppositely lying limbs on both sides engages with a positive fit into a groove on the quick change valve, and that by displa-

30

cing the bar into a release position the positive fit is lifted and the quick change valve may be pulled from the connection piece.

One embodiment example for a hysteroscope according to the invention is shown in the accompanying drawings and is described hereinafter. In the drawings there are shown in

Fig. 1 the hysteroscope in a longitudinal section with an introduced auxiliary instrument,

Fig. 2 the distal end region of the hysteroscope according to Fig. 1 in an enlarged scale,

Fig. 3 the proximal end region of the hysteroscope according to Fig. 1 in an enlarged scale,

Fig. 4 the inner shank of the hysteroscope seen from below with a means for displacing the deflection element,

Fig. 4a a section through the inner shank in the region of the deflection element,

Fig. 4b a lateral view of the embodiment form shown in Fig. 4a with an inner shank shown only partly,

Fig. 5a a rinsing attachment for removing rinsing fluid,

Fig. 5b the proximal end region of the outer shank in section,

Fig. 5c the rinsing attachment according to Fig. 5a with part sections,

Fig. 6 a quick change valve for introducing auxiliary instruments, in a longitudinal section and

Fig. 6a a cross section through the quick change valve according to Fig. 6  
5 in the region of the slider.

The hysteroscope 1 comprises an outer shank 2 which is formed ovally in cross section and which in the region of its distal end on the shank lower side is provided with a recess 3. Through this recess there may exit the distal end 28a of an  
10 auxiliary instrument 28 and this may be deflected at an angle to the instrument longitudinal axis, as this is shown in the Figs. 1 and 2 and will be described later.

At the proximal end of the outer shank 2 there is located a coupling part 4 (Fig. 5b) which serves the releasable fastening of a rinsing attachment 13 (Fig. 5a) with a handle (not shown) and also the fastening of an inner shank 21. The releasable connection of the outer shank 2 to the rinsing attachment is effected via an  
15 incision of the coupling cone 5 of the coupling part 4, this incision forming an annular groove 6. A rinsing attachment 13 may be pushed onto the middle region of the coupling part 4 and rotatably movably fixed on this by way of a clamping ring 15 which according to Fig. 5c is slotted at the top.  
20

In order to be able to slide the rinsing attachment 13 proximally onto the coupling part 4 the rinsing attachment is placed on the cone and pushed proximally.  
25 By way of the gradient of the cone the two limbs 15a and thus also the two ends of the clamping ring 15 are spread apart and laterally pivoted into an annular free space in the rinsing attachment, by which means the free inner diameter or passage of the clamping ring 15 is enlarged.

30 The rinsing attachment 13 may then further be pushed onto the coupling part 4 up to a diameter widening 4a of the coupling part 4, this extension being on the



proximal side and forming an abutment. If the limbs 15a lie above the annular groove 6 the two ends of the clamping ring 15 and its limbs 15a return into their original position (Fig. 5c) and with this engage into the annular groove 6 of the coupling part 4. By way of pressure on a pin 16 the two ends of the clamping ring 15 which according to Fig. 5c are located above may be pressed against the conical end of a screw 17. With this the two limbs 15a are spread open and the engagement of the clamping ring 15 in the groove 6 is released so that the rinsing attachment 13 may be pulled from the coupling part 4.

By way of two O-rings 9 an annular groove 7 is sealed with respect to the annular housing part 14 of the rinsing attachment 13 so that rinsing fluid via a tubing connection piece 19, a cock 18, the annular channel formed by the two parts 13 and 14 in the region of the annular groove 7 and via transverse bores 8 connecting this annular channel to a central channel in the outer shank 2 may be suctioned out of the body cavity.

Fig. 4 shows the instrument shank 21 which from the proximal may be inserted into the outer shank 2 and which amongst other things serves for receiving endoscope optics O (Fig. 4a), for leading the auxiliary instrument 28, for receiving a device 22 - 26 deflecting the auxiliary instrument as well as for supplying rinsing fluid into the body cavity.

The device for deflecting the distal end 28a of the auxiliary instrument 28 is also shown in Fig. 2. This shows two ramps arranged at an axial distance to one another, specifically a first ramp 22 and a second ramp 23, as well as a deflection element 24 in the form of a lever whose length determines the minimum distance between the two ramps, since it in a rest position between the ramps lies directed essentially parallel to the axis and in this position on introducing the endoscope 1 into the body cavity should remain in a position parallel to the instrument longitudinal axis and should not protrude outwards through the recess 3. As is evident from Fig. 2 the deflection element 24 has an oblique run-up surfa-

ce 24a which initially with the pivoting-out of the deflection element 24 lies and slides on the oblique surface of the ramp 23.

5 For the axial displacement of the deflection element 24 there serve two parallel actuation rods 25 which are arranged and guided below the inner shank 21. For bending the distal end region 28a of the semi-rigid auxiliary instrument 28 relatively large forces are required which is why the actuation rods 25 and also the deflection element 24 as well as its mounting are designed accordingly stable. In this context also important are the guide sleeves 27 which are axially passed through by the actuation rods and are rigidly fixed below the inner shank 21. The distal ends of the actuation rods 25 blend into a transverse web 25a which runs through the deflection element 24 and forms its pivoting axle 24b.

15 The auxiliary instrument is introduced via a valve 39 and with its distal end 28b first comes to bear with the ramp 22 so that the auxiliary instrument end with a further distal movement of the auxiliary instrument slides on the ramp 22 and finally assumes the first position shown dashed in Fig. 2. For the case that the auxiliary instrument end is to be deflected even further laterally into a second position this is effected by pivoting out the deflection element 24 from the rest position.

20 This is effected in that the deflection element 24 sliding up on the second ramp 23 by way of the actuation rods 25 is displaced distally with the simultaneous pivoting from the original position parallel to the axis. By way of guides 26 arranged longitudinally on both sides of the ramps 22, 23, fastened below on the inner shank 21 and equipped with longitudinal slots, it is ensured that the transverse web 25a engaging through the longitudinal slots and thus the rotation point or pivoting axle 24b of the deflection element 24 may not change with respect to the distance to the inner shank 21 and by way of this compellingly the distal displacement of the deflection element 24 in cooperation with the ramp 23 effects the pivoting-out of the deflection element and a further continuous

deflection or elastic bending of the auxiliary instrument end 28a, until finally this instrument end and the deflection element have assumed e.g. a working position shown in Fig. 2.

5        With the proximal displacement of the actuation rods 25 the deflection element 24 under the pressure of the auxiliary instrument 28 which attempts to return back into its original straight form, is pressed back from the working position into the rest position. With this the rear side of the deflection element 24 slides on the lower side of the inner shank 21. The rest position is reached when the  
10        deflection element 24 assumes the position shown in Fig. 4b and lies directed essentially parallel to the inner shank 21, wherein the surface 24a bears against the oblique surface of the ramp 23.

As one may deduce from Fig. 1 and 3 the releasable connection between the inner shank 21 and the outer shank 2 in the known manner is effected with a cone  
15        receiver 10 arranged at the proximal end of the outer shank 2 in the coupling part 4 and with a coupling cone 29 arranged on the inner shank 21, wherein with the help of a rotational lock 11 latching balls or latching elements 12 are movable into corresponding recesses in the coupling cone 29, in order thus to releasably  
20        connect the two shanks 2, 21 to one another.

To the coupling cone 29 there proximally connects a handle 30 which at its proximal-side end is provided with a fitting 32 for the supply of rinsing fluid as well as with a coupling 34 having a cone receiver, for the releasable connection  
25        of the optics O to be introduced into the inner shank 21.

As one may deduce from Fig. 3, a channel 33 connecting the tubing connection 31 and the cock 32a of the fitting 32 and the central channel in the inner shank 21 is located directly at the proximal end of the inner shank, and specifically  
30        running inclined in the direction towards the proximal end, so that this region is very easily accessible and therefore may be cleaned to the desired extent.

On the underside of the handle 30 there is provided a receiving bore 37 which runs obliquely to the instrument longitudinal axis and in which the cylindrically formed end of the connection piece 36 receiving a quick change valve 36 is unreleasably fastened for introducing the auxiliary instrument 28. For guiding the auxiliary instrument, proceeding from the connection piece 36 there is provided a slightly arcuately running channel 38 which is formed by a tube and which opens into the free space or longitudinal channel 1.2 remaining between the inner shank 21 and the outer shank 2.

The quick change valve 39 which may be inserted into the proximal end of the connection piece 36 consists of metal or elastic material and comprises on the distal side a centrally slotted elastic sealing disk and proximally a sealing cap 41 which is placed on the introduction connection piece 39a of the valve and which is provided centrally with a slotting. The releasable connection between the connection piece 36 and the quick change valve 39 is effected with a bar 42 which is displaceable transverse to the valve longitudinal axis 39b, according to Fig. 6a has a rectangular shape, is manufactured of a round material, for example spring wire, and with opposite lying limbs 42a on both sides engages into a groove 39c on the circumference of the quick change valve 39 and secures this against the pulling out of the connection piece 36 by way of the thus created positive fit connection. If the bar is displaced out of the blocking position according to Fig. 6a upwards into a release position, the positive fit connection on account of recesses 42b 42b on the inner sides of the bar limb 42a is lifted, so that the valve 39 may be removed.

The bar limbs 42a are usefully guided vertically in bores of the connection piece 36 which in pairs lie opposite one another.

On inserting the bar 42 into the annular groove 39c the quick change valve 39 is pressed in the direction of the connection piece 36 and, as long as it consists of elastic material is slightly deformed in the connection piece. If the bar 42 has

finally reached the blocking position shown in Figure 6a the quick change valve may again be relaxed somewhat proximally since the bar limbs 22b in the region of their connection to the quick change valve 39 are weakened and sunk in by way of material recesses.

5

The respective cock 18, 32a for the tubing connections or tubing connection pieces 19, 31 are equipped with levers 20, 32b with which the cock plugs may be rotated by hand and the cocks may be opened and closed. Furthermore on the handle 30 there is pivotably arranged a lever 43 with which the deflection element 24 via the actuation rods 25 may be displaced from the rest position into the working position according to Figure 2 and again back into the rest position.

10

## Claims

5

1. A hysteroscope for carrying out endoscopic operations in the uterus by way of an auxiliary instrument (28), consisting of an inner shank (21) and an outer shank (2) surrounding the inner shank whilst forming a longitudinal channel (1.2), of a first fitting (32) for supplying rinsing fluid to be led through the inner shank (21) into the uterus and of a second fitting (13) for removing rinsing fluid from the uterus via the longitudinal channel (1.2), of a third fitting (36-41) at which the auxiliary instrument (28) is introducable into the hysteroscope and is further distally movable through a working channel (38, 1.2), and of deflection means (22-24) with which the distal end region (28a) of the auxiliary instrument (28) is elastically laterally deflectable, characterised in that there is provided a first ramp (22) on which, sliding up, the distal end (28b) of the auxiliary instrument (28) moved distally through the hysteroscope is deflectable, in order with a further distal movement of the auxiliary instrument (28) to bring its distal end region (28a) into a first position, and that there is provided a deflection element (24) with which the distal end region (28a) of the auxiliary instrument (28) further is deflectable into a second position beyond the first position.

2. A hysteroscope according to claim 1, characterised in that the deflection element (24) designed as a pivotably mounted lever by way of distal displacement is pivotable out of a rest position by way of a second ramp (23) against the distal end region (28a) of the auxiliary instrument (28) in order to deflect this end region into the second position.

3. A hysteroscope according to claim 2, characterised in that the pivot bearing (24b) of the deflection element (24) is axially adjustable with two parallel

actuation rods (25) which run through stationary guide sleeves (27) attached on the outside on the inner shank (21).

4. A hysteroscope according to claim 3, characterised in that the distal ends of the actuation rods (25) blend into a transverse web (25a) which runs through longitudinal slots in guides (26) parallel to one another and attached on the outside on the inner shank (21), and which forms the pivot pin (24b) of the deflection element (24).

5. A hysteroscope for carrying out endoscopic operations in the uterus by way of an auxiliary instrument (28), consisting of an inner shank (21) and an outer shank (2) surrounding the inner shank whilst forming a longitudinal channel (1.2), of a first fitting (32) for supplying rinsing fluid to be led through the inner shank (21) into the uterus and of a second fitting (13) for removing rinsing fluid from the uterus via the longitudinal channel (1.2), in particular a hysteroscope according to one of the claims 1 to 4, characterised in that the second fitting is designed as a rinsing attachment (13), that at the proximal end of the outer shank (2) there is provided a coupling part (4) with a cone (5) and that the rinsing attachment (13) from the proximal can be placed onto the cone (5), is displaceable proximally further onto the coupling part (4), and lying against an abutment (4a) is connectable to the coupling part (4) in a rotatably movable manner.

6. A hysteroscope according to claim 5, characterised in that the rinsing attachment (13) is equipped with a slotted clamping ring (15) whose limbs (15a) on pushing onto the cone (5) may be elastically spread open and after pushing the rinsing attachment (13) onto the coupling part (4) under return deformation engage into an annular groove (6) on the coupling part (4).

7. A hysteroscope according to one of the claims 5 and 6, characterised in that on the coupling part (4) there is provided a further annular groove (7) which in cooperation with an annular housing part (14) of the assembled rinsing attachment (13)

forms an annular channel which on the one hand is in connection with the channels, of the rinsing attachment (13), leading the rinsing fluid, and on the other hand via bores (8) in the coupling part (4) is in connection with a channel (1.2) between the inner shank (21) and the outer shank (2).

5

8. A hysteroscope according to one of the claims 5 to 7, characterised in that in the coupling part (4) there is provided a cone receiver (10) into which from the proximal there may be pushed a coupling cone (29) seated on the inner shank (1), said coupling cone being releasably connectable to the coupling part by way of latching elements (12).

10

9. A hysteroscope according to claim 8, characterised in that to the coupling cone (29) there proximally connects a handle (30) on whose proximal end there is provided the first fitting (32) whose parts (31, 32a) leading the rinsing fluid via an obliquely proximally running channel (33) are in connection with the channel formed by the inner shank (21).

15

10. A hysteroscope according to claim 9, characterised in that on the proximal end of the handle (30) there is provided a coupling (24) with which optics (O) insertable into and through the instrument shank (21) may be fixed.

20

11. A hysteroscope for carrying out endoscopic operations in the uterus by way of an auxiliary instrument (28), consisting of an inner shank (21) and an outer shank (2) surrounding the inner shank whilst forming a longitudinal channel (1.2), and of an fitting (36-41) at which the auxiliary instrument (28) is introducable into and through a working channel (38,1.2) of the hysteroscope, in particular a hysteroscope according to one or more of the claims 1 to 10, characterised in that fitting (36-41) is equipped with a quick change valve (39) which has a longitudinal channel (39b) for leading through the auxiliary instrument (28), is inserted into a connection piece (36) and by way of a bar (42) can be fixed in the connection piece (36).

25

30



12. A hysteroscope according to claim 11, characterised in that the quick change valve (39) on the distal side has an elastic, centrally slotted sealing disk (40) and proximally on its introduction connection piece (39a) projecting out of the connection piece (36) is provided with a sealing cap (41) which is placed  
5 onto this introduction connection piece and which centrally on the proximal end is provided with a slotting.

13. A hysteroscope according to one of the claim 11 and 12, characterised in that the bar (42) displaceable transversely to the longitudinal axis of the quick  
10 change valve (39) in a blocking position with two opposite limbs (42a) on both sides engages with a positive fit into a circumferential groove (39c) on the quick change valve (39) and that after displacing the bar (42) into a release position the positive fit may be lifted and the quick change valve (39) may be pulled out of the connection piece (36).



**Application No:** GB 0029722.6  
**Claims searched:** 1-4

**Examiner:** Dr Jeremy Kaye  
**Date of search:** 27 April 2001

## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:  
UK CI (Ed.S): A5R (REW, REN, REP, REYX)  
Int CI (Ed.7): A61B 1/00, 1/005, 1/01, 1/012, 1/015, 1/018, 1/12, 1/303, 1/307  
Other:

### Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
Y	US 5343853 (KOMI) col.2, l.53 - col.3, l.37; col.5, ll.13-41; col.6, ll.39-46; Figures 1 and 6	1
Y	US 5320091 (GROSSI ET AL.) col.2, ll.10-41; col.5, l.31 - col.6, l.24; Figure 2.	1
Y	US 4841949 (SHIMIZU ET AL.) col.3, l.20 - col.4, l.13; col.4, ll.28-64; Figure 2.	1
A	US 4178920 (CAWOOD JR. ET AL.) col.1, l.15 - col.2, l.27; col.3, l.65 - col.4, l.19; col.5, ll.28-30; Figure 2	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.